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DECAY AND TERMITE DAMAGE IN HOUSES

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1948

THE danger of deterioration of wood in houses has been exaggerated. Subterranean termites or decay fungi cause serious damage only to those buildings that are not properly built or maintained. Prevention is cheap; cure is sometimes expensive.

The basic requirements are simple: (1) Keep termites and fungi from entering the parts near the ground; (2) use dry wood so far as practicable; (3) so build as to keep the wood dry most of the time.

The safeguards detailed in this bulletin for preventing and correcting decay and termite hazards are summarized in 10 essentials on the last page.

Washington, D. C. Issued March 1948

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6 MAY 19

Decay and Termite Damage in Houses

Prepared by the DIVISION OF FOREST PATHOLOGY, *Bureau of Plant Industry, Soils, and Agricultural Engineering,* and the DIVISION OF FOREST INSECT INVESTIGATIONS, *Bureau of Entomology and Plant Quarantine, Agricultural Research Administration*

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WHEN properly used, wood is a permanent building material for most parts of houses. Any damage by termites or decay fungi is almost always the direct result of carelessness or faulty construction. Preventive measures need not be expensive. The wise builder will naturally safeguard his house against cold winds and driving rains. He also will seek to exclude the less conspicuous but insidiously destructive soil-inhabiting termites and decay fungi.

CAUSES OF DAMAGE

Termites (fig. 1) are the most destructive of the insects that attack wood in houses. They eat the interior of the wood (fig. 2) and may cause much damage before they are detected. The kinds that cause most of the damage in this country must have constant access to moist soil, with which they can connect by tubes (fig. 3). They are relatively unimportant in the northernmost States, but precautions must be taken against them in most parts of the country.

Wood decay is caused by fungi, which are plants consisting of microscopic threads. They become visible to the naked eye when many of them occur together, as in figure 4, or when they produce the fruiting bodies from which their spores are distributed (fig. 5). Some fungi merely discolor the wood, but the decay fungi weaken or destroy the fiber. These cannot work fast at temperatures below 55 to 60° F., and

FIGURE 1.—*A* and *B*, Worker termites; *C*, winged termite; *D*, winged ant. The wasp waist of the ant and the long wings of the termite are distinguishing characteristics. *A*, *C*, and *D*, Greatly enlarged; *B*, natural size.

not at all in dry wood. There is no such thing as "dry rot"; decayed wood is often dry after it has rotted, but not while the decay is taking place. Only two species of fungi can spread from moist soil or wood into dry wood. These do so by taking their water with them.[1] These two cause very great damage to occasional buildings, but fortunately

[1] Richards, C. A. Decay in Buildings. American Wood-Preservers' Assoc. Proc. (1933) 29: 389–398, illus. 1933.

most fungi cannot conduct moisture in this way. Decay is least important in the driest parts of the country.

Wood damaged by termites can be easily distinguished from decayed wood. Termites honeycomb the wood with definite tunnels; these are separated by thin partitions of sound, firm wood (fig. 2). The decay

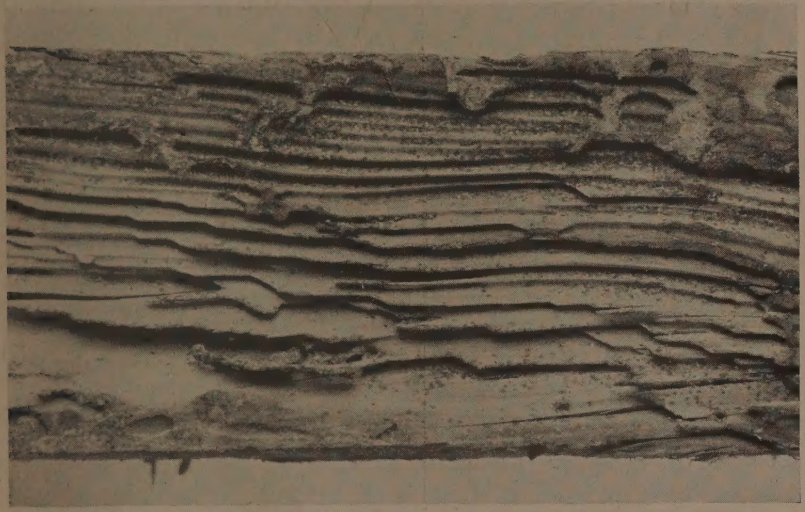

FIGURE 2.—Wood honeycombed by termites. Exterior surface has been removed to reveal the extensive tunneling within, along the grain. The wood remaining between the tunnels is firm, except in cases in which wood-rotting fungi have also been active.

FIGURE 3.—Shelter tubes made by termites over concrete foundation wall in poorly ventilated basementless area beneath a building. Many tubes are being extended downward from the damaged sill to the ground to reach moisture.

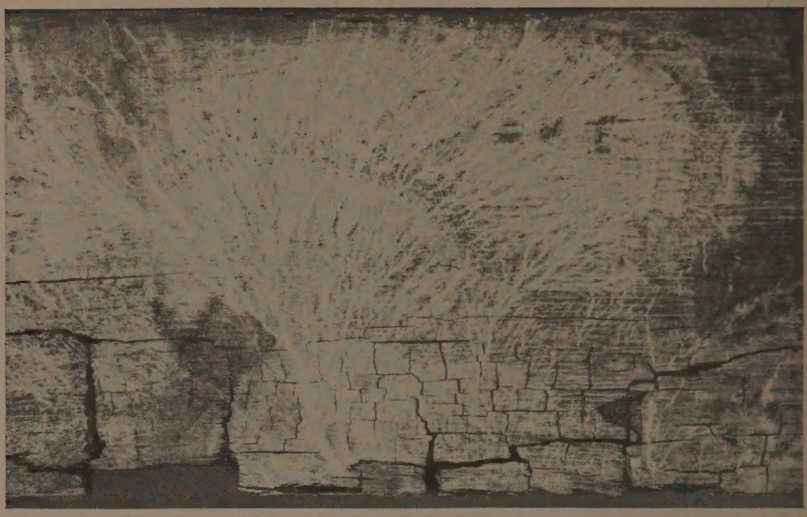

FIGURE 4.—A decay fungus and its effect on wood. The tiny threads of which the fungi mainly consist grow within the wood and can be seen there only with a microscope. Where the air is extremely moist they may develop on the surface in sufficient quantity to be visible. The upper part of the wood in this specimen is softened and weakened, and the lower edge nearly disintegrated, but there are no definite galleries such as those cut by termites.

fungi soften the wood and in the final stages cause it to shrink and crack or crumble (fig. 4). None of the fungi cause continuous clear-cut tunnels or galleries such as are produced by termite feeding. The fungi and the termites may, of course, work in the same wood. In such cases the partitions between the termite galleries are softened.

Serious damage is most often due to the following errors:

In all parts of the country:

1. Using poorly drained sites and not providing ventilation under basementless houses.
2. Building with green and infected lumber.
3. Having untreated wood members in contact with soil or concrete—this occurs especially often at dirt-filled porches.
4. Embedding ends of joists and girders in masonry near the soil.

In parts of the country where termites are active, that is, all except the northernmost States:

5. Leaving wood or paper debris under or around the house.
6. Not capping masonry foundation walls tightly.

GENERAL SAFEGUARDS

The basic requirements for protection are simple—keep soil-inhabiting termites and decay fungi from entering the lower part of the structure. To prevent decay, use dry wood so far as practicable and build in a way that will keep it dry most of the time.

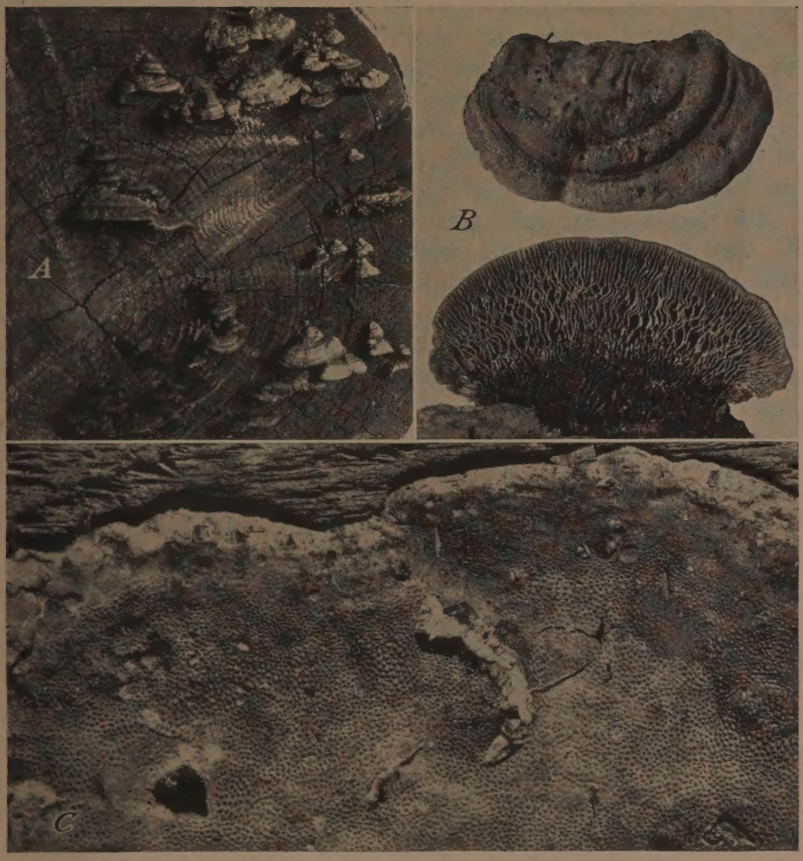

FIGURE 5.—Fruiting bodies of different types of wood-rotting fungi. *A*, Upper, and *B*, lower surfaces of one of the bracket fungi common on softwoods exposed to rain. *C*, The crustlike fruiting body of a fungus that can conduct water into dry wood. The microscopic spores by which these fungi are spread to new locations are produced on the gills and pore surfaces on the lower sides of the fruiting bodies.

Use of Dry Lumber

Dry lumber has better ultimate nail-holding capacity than green lumber, it shrinks and warps less, and it is safer from decay. Wood completely air-dry ordinarily contains less than 15 percent moisture; fortunately, decay can occur only when wood contains more than 20 percent.[2]

[2] More complete information is available in the following: U. S. Dept. Agr. Tech. Bul. 174, The Air Seasoning of Wood; and U. S. Forest Products Laboratory, Madison, Wis., Rpt. R1613, Good Wood Houses Are Built of Dry Lumber.

If only green material can be obtained, it should be open-piled on the job to let it dry as much as possible before it is used. The piles should be supported off the ground, the layers separated from each other by narrow strips of 1-inch lumber. The boards in each layer should be spaced to let air move up or down between them. If the piles cannot be put under a roof they should slope toward one end and the boards in the top layer should overlap and extend out at the front and back to keep rain off the boards beneath. Green lumber requires 60 days or more for thorough seasoning, but even a shorter period will do much to decrease the chance of decay.

Wood that is heavily discolored by blue-stain fungi also is likely to contain decay fungi; these may continue to spread as long as the wood remains moist. If such wood must be used, it is particularly necessary to have it dry before it is enclosed. Even well-seasoned wood becomes liable to decay if it takes up too much moisture.

Protection Against Rain

Roofs with considerable overhang give more protection to the rest of the house than those without. Gutters and downspouts are particularly desirable for houses without overhanging eaves.

In general, architectural frills or novel forms of construction should be studied carefully to determine whether they will provide entrance points or pockets in which moisture will remain long enough to let decay get started. Wood takes water most readily through exposed ends, as in joints.

Decay-Resistant Wood

Sapwood of all species of trees is susceptible to decay. Heartwood of most species is more durable. In Douglas-fir, southern pine, and white oak the heartwood is classed as moderately resistant. In cypress and redwood it is highly resistant both to decay and to termites and can even be used in contact with soil for a considerable number of years if there is no sapwood attached. Cedars are generally resistant to decay but not to termites. The highly durable hardwoods, as black walnut, catalpa, Osage-orange, and the better varieties of black locust, are too hard or too scarce for general use in construction. Heartwood of resistant species is increasingly difficult to obtain and cannot be the principal reliance for safety in most house construction. Where preserved lumber is not to be used, however, it is good practice to pick out the pieces containing the most heartwood for use in sills, porches, outside steps, and the lowest siding boards.

Paint and Preservatives

Paint is not a preservative. In many cases it will protect wood from intermittent wetting, especially if applied to ends and edges as

well as exposed faces and so maintained as to allow the fewest possible cracks at joints. In some other cases, as for example when applied to wood that is not seasoned, it may favor decay by hindering further drying. Painting is not a substitute for good construction details and maintenance. In warm moist climates or in rooms with very moist air, paint itself may mold and become unsightly. Paints having low oil content and much zinc oxide are safest in this respect. On the Gulf coast, where mildew is most common, fungicides to protect paint from molds can be obtained from paint stores, with instructions for use.

If proper construction methods are used, treatment of the wood with preservatives is not necessary. For protection against decay, the use of treated wood is advised for any members that are not to be properly protected against excessive moisture, unless heartwood of a naturally very resistant species is available. Treated or resistant wood is also desirable for some parts of any house if the greatest possible safety is wanted.

To be fully protected, wood must be deeply impregnated with the preservative. This can be done by treatment under pressure. Less efficient but often adequate treatment can be given by heating wood and then soaking it in a cold preservative. Wood that is cut and fitted after treatment should be given a heavy brush treatment on the cut surfaces, unless it is evident that the wood was completely penetrated by the original treatment. Stringers embedded in concrete and porches, sills, and joists are the members for which thorough preservative treatment could be most easily justified.[3]

Wood can be given some protection from decay by more superficial treatments with preservatives, but chemicals added by brushing or dipping penetrate the wood surprisingly little, except in some species through exposed ends. Such treatment is not advised for wood exposed to severe conditions, but can considerably increase the service life of wood that is to be exposed to rain but is not in contact with the ground. Its effectiveness can be increased by painting the wood after treatment. A dip treatment is also suggested for the ends of joists.

HOW TO SAFEGUARD WOODWORK CLOSE TO THE GROUND

The older type of house built well above the ground is the safest, but most people prefer the modern low type of architecture. This,

[3] More complete information on wood preservation is contained in the following reports, which may be obtained from Forest Products Laboratory, Madison, Wis.: R149, Wood Preservatives; R154, Methods of Applying Wood Preservatives; R621, Preservation of Timber by the Steeping Process; R919, Preservative Treatment of Window Sash and Other Millwork; R982, Making Log Cabins Endure; R1092, The Treatment of Sawdust Insulation for Protection Against Decay, Insects, Animals, and Fire. Additional information is available in U. S. Dept. Agr. Circular 683, Effectiveness of Wood Preservatives in Preventing Attack by Termites.

together with the increased use of second-growth sapwood, has operated to increase the decay hazard. Sills, joists, floors, and lower walls may suffer heavily from termites (fig. 6) and from decay fungi that come up from the soil. Their decay may also be favored by moisture that comes from the soil as vapor and condenses on the sills or the outer ends of the joists when the outdoor temperature is low (fig. 7). The following precautions are advised.

Drainage

Moist building sites should be well drained. If the moisture continues and no basement is to be provided, it should be helpful to cover the soil under the house with a 3- to 4-inch layer of gravel, or with asphalt roll roofing. The soil surface should slope away from the house, and downspouts should discharge into approved drains or into masonry gutters or splash blocks that lead the water several feet away from the house. Dense shrubbery or vines planted too close to the house can interfere with drainage and air movement and thus promote fungus growth and termite activity. Termites sometimes reach the exterior woodwork by tunneling through dead parts of woody vines.

Contact of Wood With Soil

Allow no wood to be in contact with the soil unless it is impregnated with a good wood preservative. Remove all wood forms, grading stakes, and spreader sticks from concrete work under houses, porches, or steps. Wood skirting or lattice should be kept off the soil by putting a low concrete base under it or by suspending it above the soil with a clearance of at least 2 inches. This also applies to wood housings around plumbing and water pipes underneath houses.

Dirt fills under concrete or masonry porch floors frequently provide points of entry for both termites and decay fungi (fig. 8, *A*). Mixing wood with the soil about the foundation is one of the surest methods of inviting termites into a building. Wood debris in the soil, even in very small quantities, enables termites to develop colonies, which may later infest the building. If the dirt under the porch comes up to the level of the sills or joists of the house, these can be protected from contact with the soil by noncorrosive metal flashing (as in fig. 8, *B*) or by building the porch as an independent unit separated from the house at all points by an air space 2 or 3 inches in width and covered at the top. A safe and perhaps easier method is to abandon the use of the dangerous dirt fill and pour a reinforced concrete porch slab. If this is done, a sufficient opening must be left to allow removal of wood forms and to serve as a permanent access for termite inspection. Where this is impracticable, sheet-metal forms are suggested.

FIGURE 6.—Termite damage to the sill and studding of a building. Having bricks between the studding is undesirable.

FIGURE 7.—Moisture condensation on joists of a defense-housing unit on a moist site. This occurs in cold weather and could in the end lead to decay. It can be avoided by ventilation or, at low cost, by covering the soil below with roll roofing.

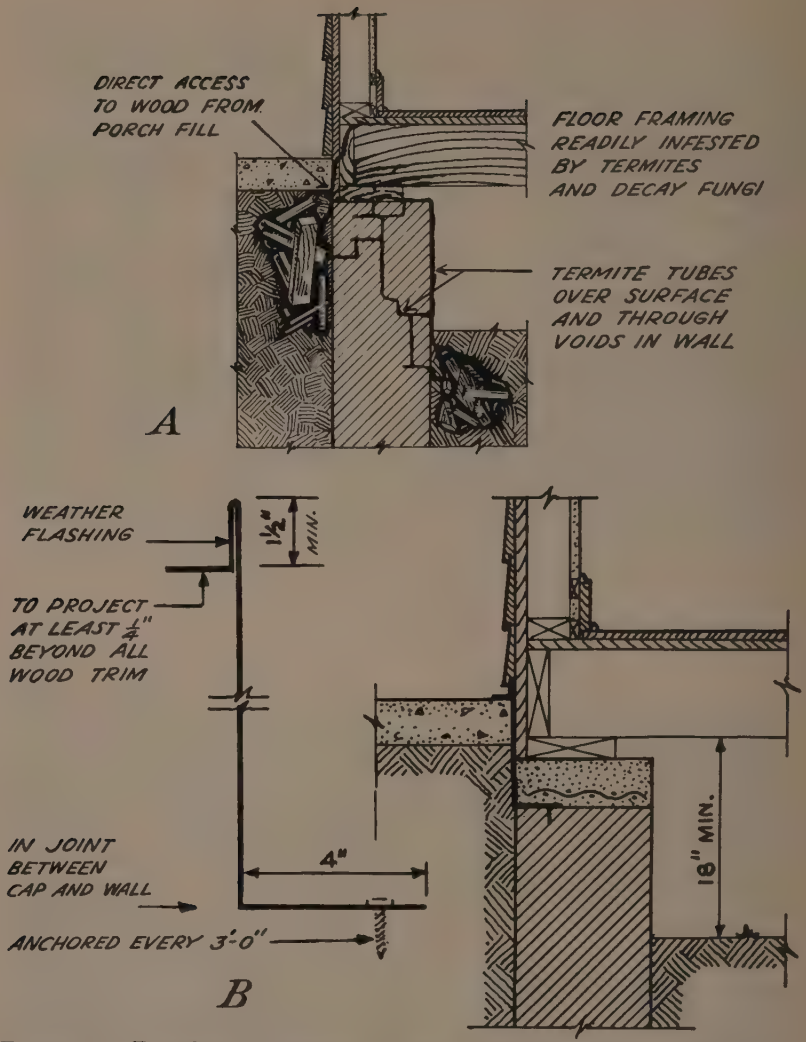
DIRECT ACCESS TO WOOD FROM PORCH FILL
FLOOR FRAMING READILY INFESTED BY TERMITES AND DECAY FUNGI
TERMITE TUBES OVER SURFACE AND THROUGH VOIDS IN WALL
A
WEATHER FLASHING
1½" MIN.
TO PROJECT AT LEAST ¼" BEYOND ALL WOOD TRIM
IN JOINT BETWEEN CAP AND WALL
4"
ANCHORED EVERY 3'-0"
18" MIN.
B

FIGURE 8.—Dirt-filled porches: *A*, Bad practice—an infestation originating in debris may spread through hidden points of access from porch fill or up through voids or cracks in a unit-type wall. Infestations in the debris encourage the construction of shelter tubes on a wall in enclosed or partially excavated areas. The most destructive of the decay fungi also are likely to enter the house from soil contacts of the kind shown here. *B*, Good practice—metal apron inserted between concrete slab and woodwork, anchored to unit-type foundation, and capped with reinforced concrete. The apron serves as a weather flashing as well as a barrier against termites and decay. The flashing should be continued 3 inches beyond the slab at both ends of the porch. If a termite shield is installed over the whole foundation the flashing can be made continuous with it and placed over the wall instead of under a cap.

Contact of Wood With Concrete or Masonry

Embedding wood in concrete near the soil is an invitation both to termites and to decay (fig. 9). This is especially true of stakes left

FIGURE 9.—Damage to untreated sleepers embedded in concrete flooring.

projecting through the concrete. Any wood placed against concrete or masonry that is in direct contact with soil should be protected from moisture by a vapor barrier between the wood and the concrete. The vapor barrier could be undiluted hot tar, asphalt roll roofing, or corrosion-resisting metal, or at least asphalt paint.

Wood pillars resting on concrete floors should be protected from floor moisture by placing them on raised concrete bases (fig. 10).

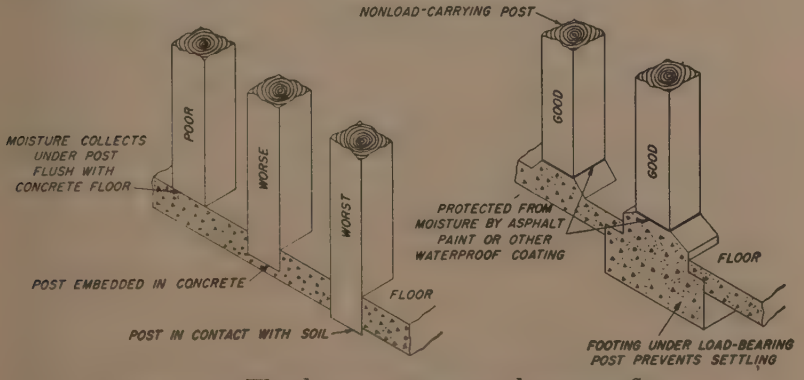

FIGURE 10.—Wood posts on concrete basement floors.

If a wood floor is laid on a concrete slab there should be a dampproof membrane under or in the slab, or the upper surface of the slab should be thoroughly coated with tar or asphalt; where termites are frequent, tar mopped on builder's felt is preferable (fig. 11). Even with such protection it is safest to have stringers and the subfloor impregnated with a preservative. Linoleum or other vapor-barrier coverings on wood floors increase the chance of trouble where moisture rises through the slab from the ground beneath.

Expansion joints between concrete floors and foundation walls, or at openings through which piping penetrates floors or walls, should be

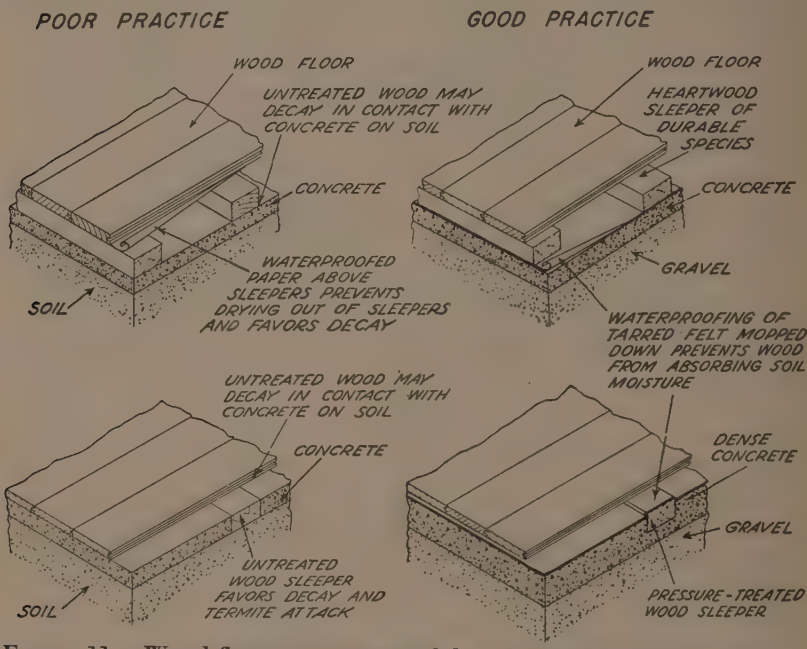
POOR PRACTICE
GOOD PRACTICE
WOOD FLOOR
UNTREATED WOOD MAY DECAY IN CONTACT WITH CONCRETE ON SOIL
CONCRETE
WATERPROOFED PAPER ABOVE SLEEPERS PREVENTS DRYING OUT OF SLEEPERS AND FAVORS DECAY
SOIL
WOOD FLOOR
HEARTWOOD SLEEPER OF DURABLE SPECIES
CONCRETE
GRAVEL
WATERPROOFING OF TARRED FELT MOPPED DOWN PREVENTS WOOD FROM ABSORBING SOIL MOISTURE
UNTREATED WOOD MAY DECAY IN CONTACT WITH CONCRETE ON SOIL
CONCRETE
UNTREATED WOOD SLEEPER FAVORS DECAY AND TERMITE ATTACK
SOIL
DENSE CONCRETE
GRAVEL
PRESSURE-TREATED WOOD SLEEPER

FIGURE 11.—Wood floors on concrete slabs. Waterproofing membranes may be placed in or under the slab instead of on it.

sealed with coal-tar pitch or coal-tar plastic cement to prevent termite entry.

Around houses with wood floors and masonry walls the outside soil grade should be kept below the level of the joists at least unless the wall is thoroughly moistureproofed. Joists or girders framed into masonry should have a ½-inch air space on each side and at the ends.

Ventilation

Under houses or parts of houses without basements, leave at least an 18-inch clearance as crawl space under all wood members. Provide an entrance to this crawl space. Have openings in the foundation walls

or skirting for cross ventilation, preferably at corners. The vents should preferably have a total net area equal to 1 square foot for each 25 linear feet of wall, or more where humidity and soil moisture are high. If closed in winter, they should be opened early in spring. Screens finer than ¼-inch mesh if used in ventilators may become clogged by cobwebs and dirt. Less ventilation is needed if the site is dry or if the whole subfloor space is kept warm by heating pipes through winter and spring.

Platform construction and the stops placed in walls in other types of construction to retard the spread of fire tend to hinder the escape of water vapor from the crawl space. This, however, is desirable from the decay standpoint, since moist air passing up through the walls may cause troublesome condensation in the walls or in the attic.

Sanitation

Leave no wood, paper, trash, or stumps under or near the house, either buried or above ground. Termites particularly may spread from such material into the wood of the house.

Termiteproof Foundations

In all but the northernmost States foundation walls or piers should be so built that termites cannot get through.[4] Poured concrete gives surest protection if so well mixed and tamped that no voids are left in it and no cracks develop. Masonry walls or piers should have all joints well filled with cement mortar. Hollow-block foundations should be capped with solid block, several layers of brick, or a reinforced-concrete cap. The concrete cap is most effective in preventing termite penetration.

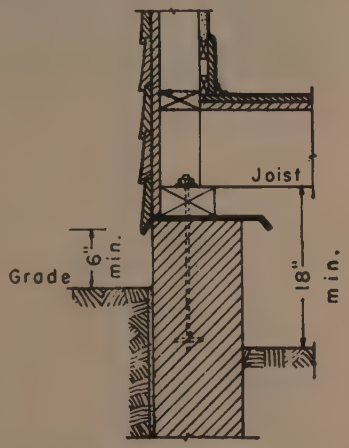

FIGURE 12.—Metal shield over uncapped unit - masonry wall to protect against termites. Metal shields are effective only if made continuous, with no gaps or loose joints. The hole through which the anchor bolt passes should be sealed with coal-tar pitch.

Termite shields (fig. 12) of corrosion-resisting metal properly installed on the foundations offer an effective safeguard. They are desirable throughout the southern part of the country or in any part where every available precaution must be taken to protect a building from attack. They are not generally advised, however, because carelessness in put-

[4] Fuller details on termite control are available in U. S. Dept. Agr. Farmers' Bulletin 1911, Preventing Damage to Buildings by Subterranean Termites and Their Control.

FIGURE 13.—Southern pine sapwood joints cut open after 3 years' exposure to rain in Mississippi. The joint in the rail over the post at the left has admitted water and resulted in decay, while the continuous rail at the right has kept rain out and prevented decay. The discoloration in the post at right is simply iron stain from the nail.

ting them on too commonly defeats their purpose. If the shields cover the top of the foundation wall completely and all joints are sealed, they make concrete foundation caps unnecessary.

HOW TO SAFEGUARD PARTS OF HOUSES EXPOSED TO RAIN

Porches and Steps

Some decay is to be expected in porch steps, floors, railings, or pillars exposed to rain. This, however, can be much delayed. Provide abundant ventilation under porches. The lower ends of stair carriages or stringers should rest on bricks, stone, or concrete, well above the ground level.

Where practicable, railings should be so built that the handrail extends over the top of the posts or balusters and keeps them from taking rain water through the ends (fig. 13). Porch floors should slope toward the outside, and frames for screens should have openings at the bottom to let rain water escape.

Upper surfaces and exposed ends and edges of floor boards and treads should be kept well painted, but the lower surfaces left unpainted. Porch pillars should have bases protected against moisture

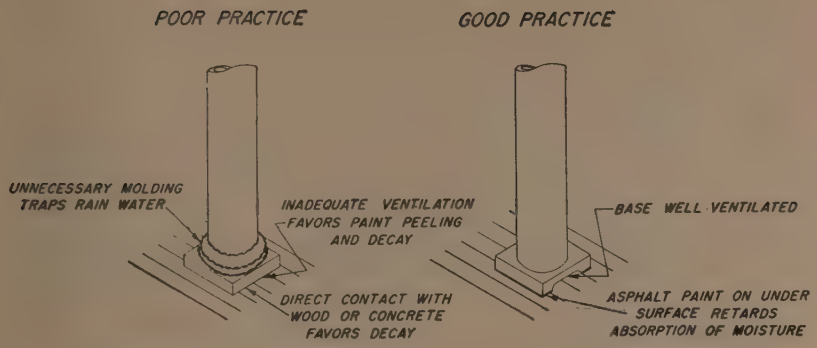
POOR PRACTICE
GOOD PRACTICE
UNNECESSARY MOLDING TRAPS RAIN WATER
INADEQUATE VENTILATION FAVORS PAINT PEELING AND DECAY
DIRECT CONTACT WITH WOOD OR CONCRETE FAVORS DECAY
BASE WELL VENTILATED
ASPHALT PAINT ON UNDER SURFACE RETARDS ABSORPTION OF MOISTURE

FIGURE 14.—Poor and good practice with porch columns.

by asphalt paint on the lower surface, and be ventilated as shown in figure 14.

Wood preserved against decay is especially likely to repay its cost for porches and outside steps. When a more thorough preservative treatment is not practicable, a 3-minute dip treatment on the job is recommended, after the lumber is cut and fitted, in one of the preservatives that do not interfere with subsequent painting. This should have considerable value, provided the wood is dry at the time of treatment and has no direct contact with the ground. Or the ends may be dipped for 3 minutes, and the sides liberally brushed. Such treatment should always come after the lumber is cut and fitted but before it is put in place, so that all ends have the protection. Solutions of pentachlorophenol, 5-percent, and of copper naphthenate containing 2 percent of copper are among the preservatives that have given good results in dipping tests for service above ground.

If no preservative is used, or after it is used, it is good practice to apply thick paint or white lead to the ends and edges of floor boards before they are put in place, to hinder the absorption of water in the joint.

Windows and Doors

Window sash may discolor or decay, especially in the colder climates where water condenses on the inside of the glass in winter and runs down into the wood. Storm sash is effective in decreasing such condensation. To hinder its absorption by the wood, sash should be primed and back-puttied before glazing (fig. 15). Part of the sash on the market has been dip-treated with a preservative which increases its resistance to fungi.

At least the lower ends of window and door screens, if not treated by the manufacturer, could profitably be soaked a few minutes in one of the solutions suggested for porches and steps, to get the preservative

into the joints. Any surfaces newly exposed when fitting should be given one or two heavy brush coats of preservative.

Garage doors should be built in a way to shed water. Rails, braces, or moldings are best placed on the inner face of the door. If on the outside, they trap water between them and the vertical members. Preservative dipping and painting all contact surfaces in joints before assembly, as suggested for porches and steps, are desirable here also. Doorframes should not extend into the concrete. Recommended construction is shown in figure 16. If glass is wanted in the door, it should

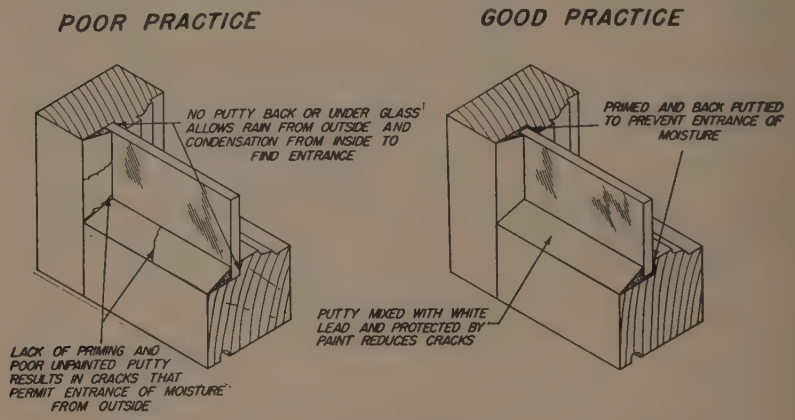
POOR PRACTICE
GOOD PRACTICE
NO PUTTY BACK OR UNDER GLASS ALLOWS RAIN FROM OUTSIDE AND CONDENSATION FROM INSIDE TO FIND ENTRANCE
PRIMED AND BACK PUTTIED TO PREVENT ENTRANCE OF MOISTURE
PUTTY MIXED WITH WHITE LEAD AND PROTECTED BY PAINT REDUCES CRACKS
LACK OF PRIMING AND POOR UNPAINTED PUTTY RESULTS IN CRACKS THAT PERMIT ENTRANCE OF MOISTURE FROM OUTSIDE

FIGURE 15.—Poor and good practice with window glass.

be set in putty as in windows, and the wood stops bedded in putty (fig. 15). The overhead type of door is less exposed to conditions favoring decay than the outward-swinging type.

Walls

Leaky cornices or gutters or downspouts can lead to decay in the wall below them. In well-maintained houses, however, frame walls well above the soil line suffer from decay only when there is some unusual combination of the factors that permit accumulation of water in the interior of the wall. The ordinary sources of moisture are green lumber, wet plaster, condensation in the wall during cold weather of water vapor from the interior of the house, the entrance of rain water through cracks, and excessive running of lawn sprinklers against the house.

Flashing of noncorroding metal can be used to keep water out of joints that are otherwise difficult to protect. Types of drop siding with rounded or slanting lower edges that lead water into the joints are not so safe as those so shaped that water drips from them to the face of the siding board below.

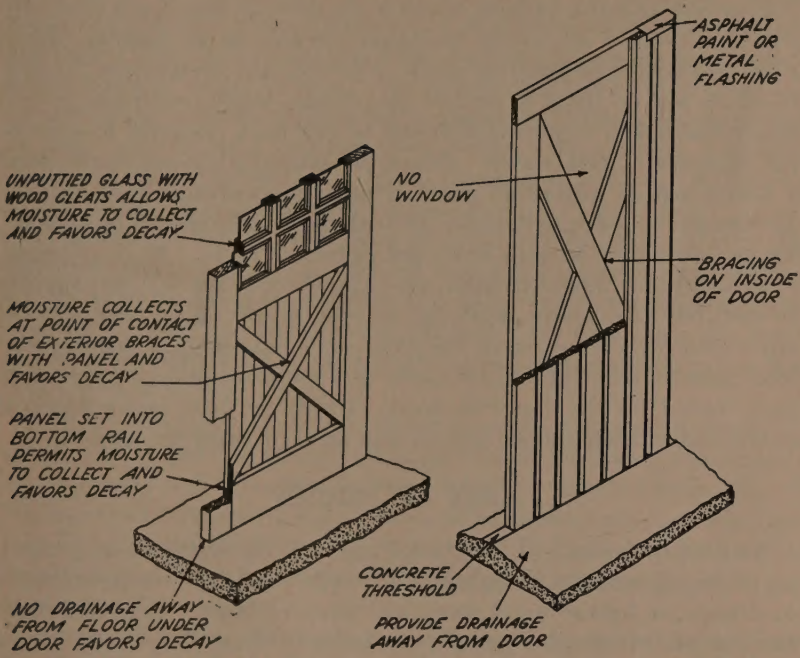
POOR PRACTICE
GOOD PRACTICE
ASPHALT PAINT OR METAL FLASHING
UNPUTTIED GLASS WITH WOOD CLEATS ALLOWS MOISTURE TO COLLECT AND FAVORS DECAY
NO WINDOW
BRACING ON INSIDE OF DOOR
MOISTURE COLLECTS AT POINT OF CONTACT OF EXTERIOR BRACES WITH PANEL AND FAVORS DECAY
PANEL SET INTO BOTTOM RAIL PERMITS MOISTURE TO COLLECT AND FAVORS DECAY
CONCRETE THRESHOLD
NO DRAINAGE AWAY FROM FLOOR UNDER DOOR FAVORS DECAY
PROVIDE DRAINAGE AWAY FROM DOOR

FIGURE 16.—Poor and good practice with garage doors. If window is installed, prime and back-putty before glazing and set cleats in putty mixed with white lead.

Some building papers, especially those with a continuous internal layer of asphalt or a shiny asphalt coating, greatly hinder the passage of moisture vapor. In a cold climate they should be put on the inner face of the studding. Insulating material having a vapor-barrier surface should be placed in the wall so that the barrier surface is at the inner (warm) face of the wall. For sheathing, tar paper is safer than asphalt-laminated or glossy-coated papers.

The danger of decay of siding is not considered sufficient to justify the expense of general preservative treatment. In warm, moist climates, however, before installing siding it may pay to dip the ends of siding in one of the preservatives mentioned in the section on porches. It is desirable also to give all surfaces of the siding boards for the lower part of the wall a heavy brush or spray treatment with the preservative. Painting the ends of the siding is also good practice. For termite prevention the lowest board should be at least 6 inches above the outside soil level.

USING NEW TYPES OF BUILDING MATERIAL

Plywood and the various fiberboards used in recent low-cost construction require in general the same precautions as lumber. Resin glues employed in exterior-grade plywood are themselves fungus-resistant but do little to protect the wood. Joint construction with either fiberboard or plywood should be carefully designed to prevent the entrance of rain water. Edges of exposed plywood should have a heavy coat of white-lead paint or other moisture-resistant coating. Horizontal strips or battens on the outside of walls should be avoided, for as a rule they let rain water get in behind them. With plywood, exterior grades should be used not only where there will be exposure to rain but also where employed as roof sheathing or over a crawl space beneath a house, since the glues commonly used in interior plywood can be disintegrated by molds at a moisture content lower than that needed for the decay of wood. Insulation bats under floors, if over moist soil, should not depend on a layer of paper for support.

CARE OF HOUSES

No kind of house will long stand neglect. Leaks in roofs, gutters, or plumbing and the clogging and overflow of gutters, downspouts, or drains can lead to wood decay and termite attack. Repeated overflowing of refrigerator drain pans leads to decay, especially if the water accumulates under linoleum. Cold pipes that "sweat" and moisten adjacent wood for long periods should be insulated. Occupants who close the ventilators under their basementless houses in winter too often fail to open them in spring. Soil and trash allowed to pile up against the wall, or firewood or lumber stacked in contact with walls or sills, may lead to decay or termite attack.

For proper maintenance any house that has wood members near the ground should be thoroughly inspected once a year, not only outside but also underneath. This should preferably be early in spring. Careful inspection is particularly needed around closed-in porches and boxed-in pipes, where termites are likely to build hidden tubes to the woodwork above.

If inspection shows termite tubes, these should be destroyed and the nearby soil poisoned with a toxic chemical applied in a trench along foundation walls and piers.

Mixtures useful for this purpose are a 5-percent solution of pentachlorophenol in fuel oil; 1 part coal-tar creosote, orthodichlorobenzene, or trichlorobenzene to 3 parts fuel oil; or a 10-percent solution of sodium arsenite.

Sodium arsenite is extremely poisonous, and the other chemicals are irritating to the skin. All should be handled with care.

The following procedure may be followed in applying the chemical.

1. Dig a trench the width of a shovel around all piers, continuous walls, and vertical pipes. A trench a few inches deep is ordinarily sufficient where the foundations have shallow footings or where there are no voids or cracks present. A much deeper trench may be necessary along basement foundation walls, especially if they are constructed of unit masonry or have developed cracks. The trench, however, should not extend below the top of the foundation footing. All cracks should be carefully sealed with coal-tar pitch.

2. Where the footing is shallow pour part of the chemical into the bottom of the trench and the rest on top of the replaced soil. Under buildings with partial excavations and under porches it may be desirable not to refill the trench with the soil. In either case the total quantity used should be at the rate of not less than one-half gallon per linear foot of trench.

3. Where footings are deep a trench about 30 inches deep should be made. After treating the bottom of the trench with part of the chemical, replace about 6 inches of soil and make a second application of the chemical. Repeat this process so as to provide an even distribution from the bottom to the top of the trench. Such a treatment will require a total of 10 gallons per 10 linear feet of trench, or 1 gallon per linear foot.[5]

If noticeable decay is found or if sills or joists are persistently wet and thus likely to decay, destroy any fungus strands that may be found connecting the decay with the soil and dry out the space under the house. Drying out can be done in various ways, as by increasing the number of vents, keeping them open a larger part of the year, providing roof gutters and downspouts for houses that lack them, and carrying all runoff away from the building.

A simple way to prevent excessive moisture in the air of the crawl space is to cover the soil under the house, as it is usually the source of the excess moisture. This can be done at low cost, simply by laying down a complete covering of roll roofing on the ground, lapped 2 or 3 inches but without edge fastening. The grade weighing 55 pounds per roll of 108 square feet appears sufficient. Building papers or felts are less satisfactory for this purpose. If water persistently stands under the house, that of course must first be drained off.

Wood used to replace any that is made useless by decay should be dry. If the sources of the moisture that caused the decay infection are entirely eliminated, it is necessary to replace only such wood as is weakened. When there is any doubt as to the moisture proofing, however, and especially if the original infection has spread rapidly, it is safest to remove also the apparently sound wood 2 feet in each direction

[5] See footnote 4, p. 13.